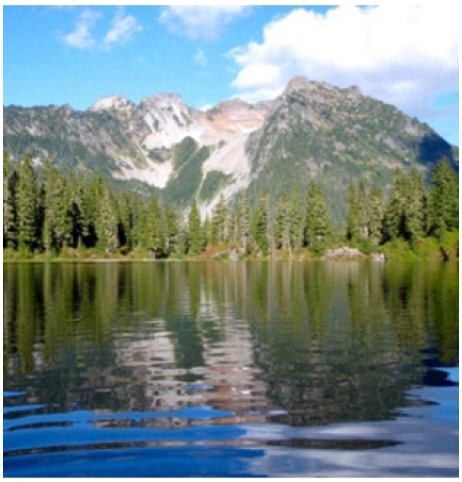
North Cascades Resource Brief

National Park Service
U.S. Department of the Interior

North Cascades
National Park Complex



TOP: Bathymetry map of a mountain lake
BOTTOM: Ipsoot Lake

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Mountain Lakes Monitoring

Three National Park units (North Cascades, Mount Rainier, and Olympic) in the NPS North Coast and Cascades Network (NCCN) have developed a Mountain Lake Monitoring Program that is designed to monitor trends in conditions of park mountain lakes and provide information concerning ecosystem stressors including climate change, air pollutant deposition, non-native species, and visitor use impacts. The program as funded through the NCCN is limited to only six to eight sites, sampled annually, at each of the three parks. This design is adequate to provide trend information at both 'network' and 'park' spatial scales; however, more sites are needed in order to address questions of status (e.g., How many lakes in the 'park' meet or exceed a given criteria or threshold; such as water temperature, that is representative of their condition).

The Skagit Environmental Endowment Commission (SEEC) has provided additional funding (2009-2013) support for the NOCA component of the NCCN Mountain Lakes Monitoring Program. SEEC funds are being used to expand our overall representation of lakes in the park's monitoring program, therefore enhancing our ability to provide estimates of both status and trends concerning important lake attributes. With these funds we are able to sample three additional lakes each year. The additional lakes have been incorporated into a 5-year rotating panel where a different set of three lakes are sampled in each year of the 5-year rotation, resulting in a total of 15 additional lakes sampled in a 5-year cycle. All lakes were selected using a procedure that provides a spatially balanced (approximately evenly disbursed throughout the park) random set of locations that meet the protocol selection criteria (≥ 0.4ha and ≤6.0ha, max. depth >2.5m, and elevation representative of high forest and subalpine zones).

This procedure produces an ordered list of all sites considered for sampling that meet the protocol selection criteria The first six ordered sites were chosen to represent the annual sample sites at NOCA. Starting at this point in the ordered list, the new sites (SEEC funded) selected for the 5-yr rotating panels were sequentially chosen from this list. The first three sites selected were allocated to the first 5-yr panel (sampled in 2009), the next three sites were allocated to the second 5-yr panel and so on until all 15 sites were allocated to 5-yr panels.

Methods for sample site selection, field data collection, and data analysis follow the "Protocol for Long Term Monitoring of Mountain Lakes in the North Coast and Cascade Network of National Parks", drafted by Glesne and others in 2010. This protocol received formal peer review and is slated for publication in 2012. The document will include sampling strategies for target populations in additional lakes to help detect changes in "status", which is a key objective for the SEEC project.

Field Sampling

In 2011, all annual and 5-year panel sites (9 lakes) were sampled in August and September. Sampling attributes and procedures are described in the NCCN Mountain Lakes Protocol. The following tasks were completed during 2011:

- Water samples were collected from nine lakes for measuring concentrations of nutrients, anions and cations, dissolved organic carbon, total

LEFT: Non-native Yellowstone Cutthroat trout, and Rainbow x Cutthroat trout hybrids sampled at Ipsoot Lake in 2011
RIGHT: Long-toed salamander typically found in NOCA mountain lakes

dissolved solids, acid neutralizing capacity, and chlorophyll are currently being processed by contracted labs.

- Bathymetric data for the three new lakes sampled in 2011 were collected.
- Lake water level benchmarks were established at the three new lakes and water level measurements were recorded for all nine lakes.
- Water clarity was measured at all nine lakes using a Secchi disk (Secci visibility of the 19.4 m sampled at Copper Lake in 2011, exceeded that of all other sites in the program).
- Shoreline disturbance was measured at multiple shoreline (3x10m) and near-shore (7x10m) plots located at 50m intervals around the lake perimeter. Disturbance scores ranging from 0 (none) to 4 (severe) and primary landcover types were recorded for all plots at each of the lakes. Shoreline disturbance was evaluated as the percent of plots with a disturbance core of >0. No disturbance was found at five of the nine lakes analyzed with SEEC funding, during 209-2011. Disturbances were recorded at 18.8% to 38.4% of the plots surveyed at the other four lakes. Most disturbances are attributed to the presence of social trails.
- Continuous temperature data loggers were deployed at all sites for measuring air temperature and lake water temperature. The data loggers record temperature at 30 minute intervals throughout the year. Temperature data from the six annual sites was retrieved and data loggers were re-deployed.
- Zooplankton samples were collected at all lakes, including replicates at two of the nine lakes. Specimen identification and enumeration for 2010 samples has been completed.
- Time and area constrained shoreline benthic macroinvertebrate samples were collected at all lakes, including replication at two of the nine lakes.
- Replicate amphibian visual encounter surveys of the entire shoreline of each lake were conducted. Salamanders have been observed at five of the nine lakes surveyed with SEEC funding in 2009-2011.

Gill nets were set at all lakes to determine the presence of fish and their relative abundance. During 2010, fish were collected in low abundance at four of the nine lakes sampled (MR-09-01, Ipsoot, Bowan, and Upper Triplet). Introduced fish populations are found at three of the nine lakes surveyed with SEEC funding in 2009-2011 and in two of the six NPS annual sampling sites. Salamanders are also found in two of the six NPS annual sampling sites.

Discussion

The mountain lakes monitoring program at North Cascades, Mount Rainier, and Olympic National Parks tracks the health of mountain lakes and resources and guides current and future management decisions. By using a standard set of protocols, a cohesive and complex data set is produced each year. The ability to compare data across time and space is a tremendous asset. All data is entered into the NCCN Mountain Lake Database and is available for specialists to review and note changes. In addition to this baseline of study, the 5-yr SEEC funded project currently underway, focuses on "status" and adds to the number of sites being monitored. Day-to-day human impacts and broader factors like climate change influence the delicate balance of aquatic resources in mountain lakes. The monitoring program helps us to get an empirical view of just how the overall health of mountain lakes is affected, and consider what we might do about it.